

Appl. No. : 09/511,934
Filed : February 24, 2000

REMARKS

Applicants respectfully request reconsideration of the application in view of the following remarks.

Rejection Under 35 U.S.C. § 103

Claims 1, 4-7, 9-10, and 21 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Frankel in view of Kao.

In the Response to Amendment, the Examiner states that it is not clear if during the experiments shown in the Declaration all other factors affecting cleaning such as the temperature of other surfaces) were held constant. The Supplemental Declaration accompanying this Response clarifies that all the experiments were conducted in accordance with the example of the specification and, except for the cleaning temperature, all the conditions including the temperature of the showerhead were constantly applied to the experiments (¶¶2, 3).

As described in the specification (page 4, the first paragraph) and also in ¶4 of the Supplemental Declaration, the inventors discovered 1) when the temperature exceeds 470°C, even aluminum nitride reacts with fluorine active species to generate aluminum fluoride, 2) when the surface temperature of a heater exceeds 500°C, generation and emission of aluminum fluoride occurs and causes damage to a reaction chamber, and 3) aluminum fluoride emitted from the heater adheres to a showerhead of relatively low temperature (100-250°C). At 470°C, the reaction between aluminum nitride (heater surface) and fluorine active species (cleaning gas) can fully be suppressed, thereby preventing generation of aluminum fluoride. Because no aluminum fluoride is generated at 470°C, no accumulation of aluminum fluoride may be observed even on a showerhead surface having a low temperature (¶5 of the Supplemental Declaration). The first experiments in the previous Declaration shows that when cleaning was conducted at 470°C, no trace of wiping was shown, indicating no degree of accumulation of particles. Further, this surprising effect was substantiated and evidenced by the second experiment in the previous Declaration showing that when cleaning was conducted at 470°C, because of no accumulation of particles on the showerhead, the film thickness and film stress did not change even after processing 2,000 wafers (¶6 of the Supplemental Declaration, and Figs. 3-5 of the present application). Thus, the temperature 470°C contributes to the results which were qualitatively different rather than quantitatively different. At 470°C the reaction between aluminum nitride (heater surface) and

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fluorine active species (cleaning gas) can fully be suppressed, and substantially no degree (not simply a less degree) of accumulation of particles is observed, and this surprising effect is evidenced by the film thickness and film stress tests. The temperature 470°C is truly the critical temperature.

In contrast, Kao specifically states "the temperature of pedestal 12 (the heater) is preferably maintained between about 400°C and 700°C, and is most preferably about 550°C." (column 17, lines 59-61). Clearly, Kao does not realize 1), 2), and 3) above. General suggestions such as "the chamber parameters may vary widely" are not sufficient to negate the criticality of the temperature 470°C. Kao's concern is over-etching and Kao shows no consideration of suppression of the reaction between aluminum nitride and fluorine active species. Neither does Kao, Frankel does not teach or even suggest the critical temperature 470°C. Frankel specifically states "constructing the heater 25 of aluminum nitride effectively eliminates this problematic reaction during cleaning." (column 31, lines 65-67). Frankel clearly fails to realize at least 1) and 2) above.

Thus, Applicant respectfully traverses the Examiner's conclusion "the temperature 470°C is neither critical nor unique." The claims could not be obvious over the prior art, and Applicant respectfully requests withdrawal of the rejection.

CONCLUSION

In light of the Applicants' foregoing Remarks, it is respectfully submitted that the present application is in condition for allowance. Should the Examiner have any remaining concerns which might prevent the prompt allowance of the application, the Examiner is respectfully invited to contact the undersigned at the telephone number appearing below.

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410. A duplicate copy of this sheet is enclosed.

Respectfully submitted,
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Dated: August 21, 2003

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